Pesticide Levels in Fish of the Northeast Pacific

by VIRGINIA F. STOUT
U.S. Bureau of Commercial Fisheries Technological Laboratory
Seattle, Washington 98102

During the past year, a program was initiated to monitor the pesticide levels of edible fish in the Pacific Northwest. The residues monitored were DDT and its metabolites, DDE and TDE. The species sampled were anchovy (Engraulis mordax), Dungeness crab (Cancer magister), English sole (Parophrys vetulus), hake (Merluccius productus), ocean perch (Sebastodes alutus), starry flounder (Platichthys stellatus), true cod (Gadus macrocephalus), and yellowtail rockfish (Sebastodes flavidus)[1]. Since only minimal information about pesticides in fishery products appears in the literature, our results may prove useful to others in the field.

Experimental Methods

The samples were extracted (1) and analyzed (2) according to standard methods. The sample size was adjusted to keep the fat

[1]Oysters were intentionally omitted from this study because they are under monthly surveillance as part of the National Pesticide Monitoring Program initiated by Philip A. Butler, U.S. Bureau of Commercial Fisheries Biological Laboratory, Gulf Breeze, Florida.

Bulletin of Environmental Contamination & Toxicology,
Vol. 3, No. 4, 1968, published by Springer-Verlag New York Inc.

content below 2 g. Except for individual analyses of anchovies, all fish samples weighed at least 20 g. Although the florisil PR[2] was activated at 145°, part of the endrin still appeared in the 94+6 fraction. Dieldrin, however, was completely recovered in the 85+15 fraction. Since the endrin GLC peak was well separated from the other peaks, its presence in the 94+6 eluate was ignored. A Wilkens 600D gas chromatograph with a tritium detector and a 5'x1/8" glass column containing 2% SE-30 on HMDS treated 80/100 mesh Chromosorb W at 195° was used for quantitation. The identity of peaks was confirmed using p-values (3).

The reported values for DDT include both o,p'- and p,p'-DDT. They were obtained by comparison with technical DDT, in order to better approximate the toxicologically significant amount of organochlorine compounds present.

In general, a standard error of about 15% can be assumed.

Results

The data are tabulated. All samples included in an individual entry are from the same catch of fish. Where male and female samples are listed sequentially, they are from a single catch. The inclusion of anchovy and hake as edible species derived from the current use of meal from them for livestock feeding and the projected production of marine protein concentrates from species

[2]Trade names referred to in this publication do not imply endorsement of commercial products.

TABLE

Pesticide Residues in Various Species of Fish and Shellfish

Species	Source	Sex	Number of fish analyzed[a]	Residues (ppm.)		
				DDE	TDE	DDT
Anchovy	Grays Harbor, Wash.		24	0.074	0.074	
			19	0.074	0.098	
			4[a]	0.058-0.172	0.073-0.244	
Crab	Destruction Island, Wash.	M	1	0.039	0.011	---
	Ilwaco, Wash.	M	4[a]	0.027-0.040	0.017-0.021	trace-0.013
English sole[b]	Blaine, Wash.	F	3[a]	0.009-0.016	0.009-0.016	0.010-0.019
		Immature	1	0.053	0.071	0.058
Hake	Saratoga Passage, Wash.	F	10	0.058	0.047	0.090
	" "	M	12	0.042	0.030	0.043
	Port Susan, Wash.	F	11[a]	0.038-0.083	0.030-0.090	0.065-0.147
	" " "	M[c]	5[a]	0.057-0.111	0.062-0.074	0.101-0.223
	Near Cape Foulweather, Ore.		12	0.074	0.068	0.143
Hake meal	Near Aberdeen, Wash.			0.267	0.027	0.080
Ocean perch	Hecate Strait, B.C.		[d]	0.012	trace	0.013
Starry flounder[b]	Blaine, Wash.	F	1	0.018	0.026	0.013

TABLE (continued)

Species	Source	Sex	Number of fish analyzed[a]	Residues (ppm.)		
				DDE	TDE	DDT
True cod[b]	Blaine, Wash.	Unknown	2	0.005-0.006	0.006-0.007	0.004
Yellowtail rockfish						
Fillets	Hecate Strait, B.C.	F	8	0.017	Trace	0.004
Remains[e]	" " "	F	8	0.042	0.006	0.021
Fillets	" " "	M	18	0.030	Trace	0.014
Remains[e]	" " "	M	18	0.076	0.009	0.051
Fillets	Ilwaco, Wash.	F	13	0.119	0.022	0.048
Remains[e]	" "	F	13	0.256	0.055	0.104
Fillets	" "	M	14	0.092	0.028	0.036
Remains[e]	" "	M	14	0.416	0.092	0.194

[a]Composites, unless a range of values is given.

[b]Fillets only.

[c]Different catch from preceding entry.

[d]16 fillets.

[e]Fish after removal of fillets.

not currently consumed directly. In comparing the data for hake meal with that of whole fish, the difference in water content must be considered (hake meal 4-6%; whole fish 75-80%).

Analysis of DDT in anchovy is complicated by a GLC peak with a retention time only slightly longer than that of DDT. The interference had a p-value in acetonitrile/hexane of 0.71 compared to DDT 0.38 in this laboratory or 0.35 in the literature (3). The presence of a small amount of DDT could be recognized by a shoulder on the leading side of the interference peak but, since only about 0.010 ppm. appeared to be involved, further analysis was dropped.

Since o,p'-DDT overlapped with p,p'-TDE in the GLC quantitation on SE-30, the presence of large amounts of DDT required correction of the apparent TDE concentration for o,p'-DDT included. Correction was achieved by using the p,p'-DDT concentration and the ratio 21:70 of o,p'- to p,p'-DDT in technical DDT (4) and, therefore, in nature.

The 85+15 chromatographic fraction caused gross contamination of the detector and the facilities for cleanup were not regularly available. Consequently, the 85+15 pesticide extracts from fish were merely examined cursorily. At random about one out of three samples was quantitated. The dieldrin and endrin content were generally insignificant. Occasionally a sample would show up to 0.006 ppm. of one of these compounds. p-Value analysis was not, however, performed so the presence of these compounds is scarcely confirmed.

Discussion

The drainage of pesticides through the Columbia River and Puget Sound provides an obvious source of contamination of significant toxicological consideration to the fishing industry and the consuming public of the Pacific Northwest. Evidence from fish collected in California waters (5) indicates that pesticide levels in that area have not been alarmingly high, but no information about Pacific Northwest specimens has been publicly available. To keep abreast of the current situation a survey of the more common local species has been undertaken.

As the data indicate the level of pesticide residues in marine products is substantially below the currently acceptable FDA tolerance for beef (7 ppm.). As might have been anticipated, fillets contain substantially lower pesticide levels than the remaining carcasses. The pesticide levels in fillets undoubtedly represent an even more accurate estimate of the human ingestion level than do whole-fish data, although the latter are of more direct biological interest.

The most striking results are those for yellowtail rockfish. A distinctly larger amount of pesticides occurs in the fish from Ilwaco, Washington, at the mouth of the Columbia River than in those from Hecate Strait, British Columbia, where no major river is entering the ocean. Obviously the agricultural run-off from Washington and Oregon is reaching the ocean fish nearby.

Acknowledgment

The able technical assistance of Michael Metcalf is acknowledged.

References

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